Rhode Island Department of Transportation

Linear Stormwater Manual

DRAFT - NOVEMBER 2, 2018

Brian Moore, PE

RIDOT Stormwater Administrator

RIDOT

Objectives of the Linear Manual

SAVE MONEY

- Save time (process)
- Clarify WBS deliverables
- Standardization submissions to OSM and RIDEM
- Clarify Consent Decree and Permitting to make 1 set of instructions for RIDOT designers

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Why This Manual ?

- Consent Decree
- Stormwater Control Plans
- Consistent, Reliable & Predictable Goals and Documents for OSM, RIDEM and CRMC
- Maintenance Approved Designs
- Framework around Maximum Extent Practicable (MEP)

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Eric Beck, PE, Chief

Groundwater and Wetlands Protection

RIDEM

ANONYMOUS POLL EVERYWHERE

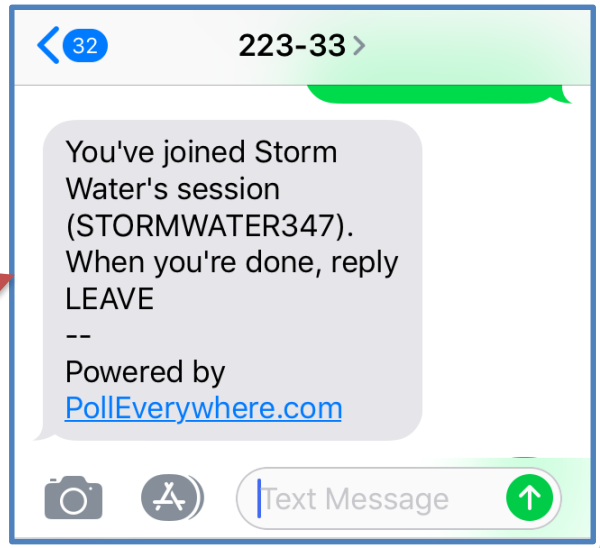
Poll EVERYWHERE

- Text To: 22333
- Text the word

Stormwater347

- Hit send

If you were successful – you should get the response:



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Did you read the Draft RIDOT Stormwater Linear Manual?

Yes (I love this stuff! I eat, drink and breathe stormwater)	**A**
Sort of...At least until I fell asleep	**B**
I scanned the slick pictures	**C**
Uhm...no	**D**

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Issues we tried to resolve…..

Issues	Linear Manual Response
What if my project doesn't trigger a permit?	This manual is used regardless of permitting. All projects must consider stormwater.
Its too expensive!	Consistent, Reliable, Process that follows the WBS
Is this what you want?	Templates
Did the design contractor submit the right information?	Defined Deliverables
But it's just a little project..do I really need to do this? "You're killing me"	Maximum Extent Practicable (Exit Ramps)
Will this be maintained?	All BMPs/STUs are approved by Maintenance

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Consent Decree Compliance Plan

Capitol (TIP) Projects

Retrofits (Office of SW Management)

Enhanced Non Structural BMPs

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CAPITOL PROJECT DEMOGRAPHICS

2% of Projects next over 10 years

New Roadway Construction

- For increased impervious projects (new roads) RISDISM - Goal is no further degradation
- Use Linear Manual Practices and other tools found in this manual

98% of Projects over next 10 years

Redevelopment/Reconstruction

- The goal (consent decree/CWA) is to **improve the receiving water** to the Maximum Extent Practicable
- Use all of the tools, goals, and MEP found in this Linear Manual

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Stormwater Control Plan

Capitol (TIP) Projects

Retrofits (Office of SW Management)

Enhanced Non Structural BMPs

TMDL GOAL

50%

X %

Y %

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What is this Manual?

- **PROCESS** - Outlines a **Consistent, Predictable & Reliable** process.
- **STANDARDS** – Specifies WBS Deliverables (e.g. 1.14 proposed drainage).
- **RESOURCES** - Worksheets and Templates

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How to Use This Manual?

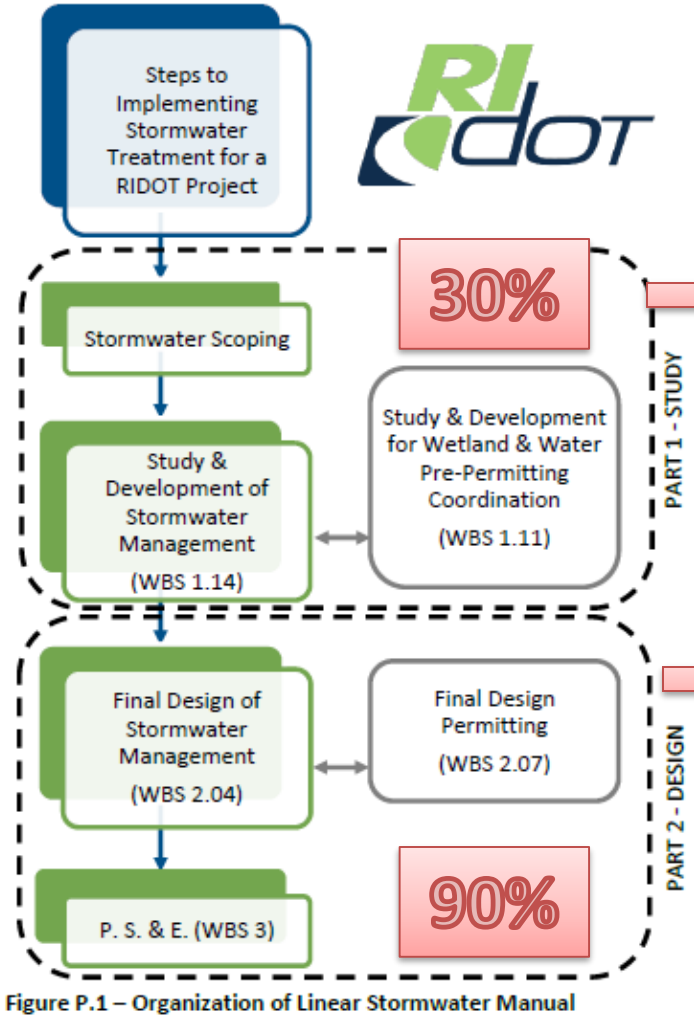

Figure P.1 – Organization of Linear Stormwater Manual

Study & Development WBS 1.14

- Appendix A checklist Part 1 & 2
  - Worksheet A
- MEP worksheet
- Existing Drainage
- Pre-app (if recommended)
- OSM Review

Final Design WBS 2.04

- Appendix A checklist completed
- Hydraulic Report
- Plans/cross sections
- SESC Plan
- O&M References
- OSM Review

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SCOPING

PART 1 – STUDY

Section 1.1 – Scoping

Typically done by RIDOT Staff Internally

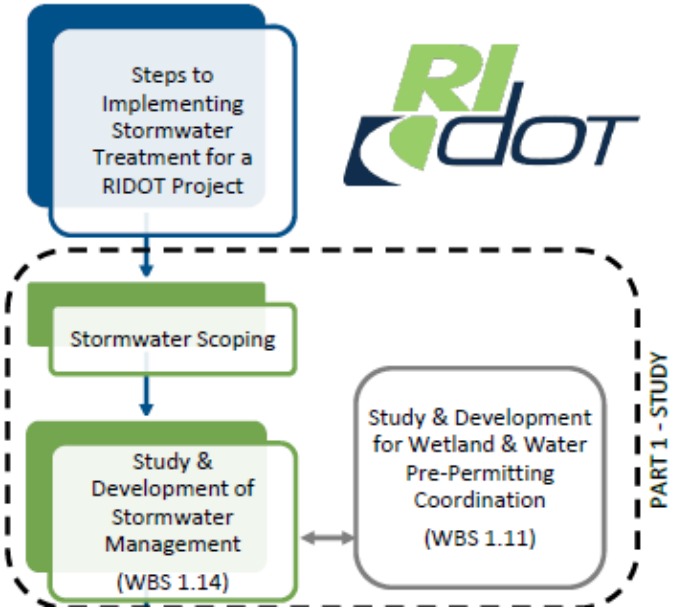
1.1.1 – Introduction

1.1.2 – Steps for Stormwater Scoping

Step 1: Determine Linear Manual Applicability

Step 2: Assess Existing Stormwater Infrastructure

Step 3: Identify Environmental Considerations that Impact Stormwater



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Scoping – Step 1

STORMWATER RELATED CONSIDERATIONS
(exerpted from scoping document)

- **Applicability**
- **Level of Effort - MEP (stormwater impaired)**
- **"red flags"**
- **Preliminary drainage in your area**

ENVIRONMENTAL CONSIDERATIONS

Environmental Document Type Anticipated (Check if needed or should be considered)
CATEGORICAL EXCLUSION (CE)

X	Title VI Analysis	Required
X	Section 106/Historic Properties, list:	Bridge is not historic. Section 106 process can be completed with PA Form I. If working outside of the existing edge of pavement CRU, review required for potential archaeological survey/standar process.
	Archaeological Sites, list:	
	Cemeteries, list:	
	Section 4F or 6F Properties, list:	
	Indian/Tribal/Federal/Wetland Reserve Program Properties, list:	
	Hazardous Waste Sites, NPL/CERCLIS/AST/UST/LUST, list (1/4 mile radius):	no RIDEM known sites identified within 1/4 mile of either lo
X	Potential Threatened & Endangered Species:	Yes
X	Project within/adjacent to RIDEM NHA:	Yes
	Potential MMPA Species:	n/a
X	Cold Water Fishery, Name of waterbody: Scott Brook	Yes
	Tidal Water, Type:	n/a
	Navigable Waterway, Federal Channel:	
	EFH/Anadromous Species, list with seasonal restrictions	
	Farmland	no
	Wetlands	no hydric soils or NWI polygons mapped in potential project
	Scenic Rivers/Study River	no
X	Groundwater Classification	Leigh = GA; Scott = GAA recharge
	SSA	no
	Wellhead Protection Area	none identified
	Drinking Water Supply Watershed	no
X	ONRW/SRPW	Yes
X	HUC 12 Watershed(s), list:	Peters River - Blackstone River 010900030208
X	Impaired Waters (type of impairment), list:	Yes
	TMDL & Category:	
	TMDL Approved, date:	

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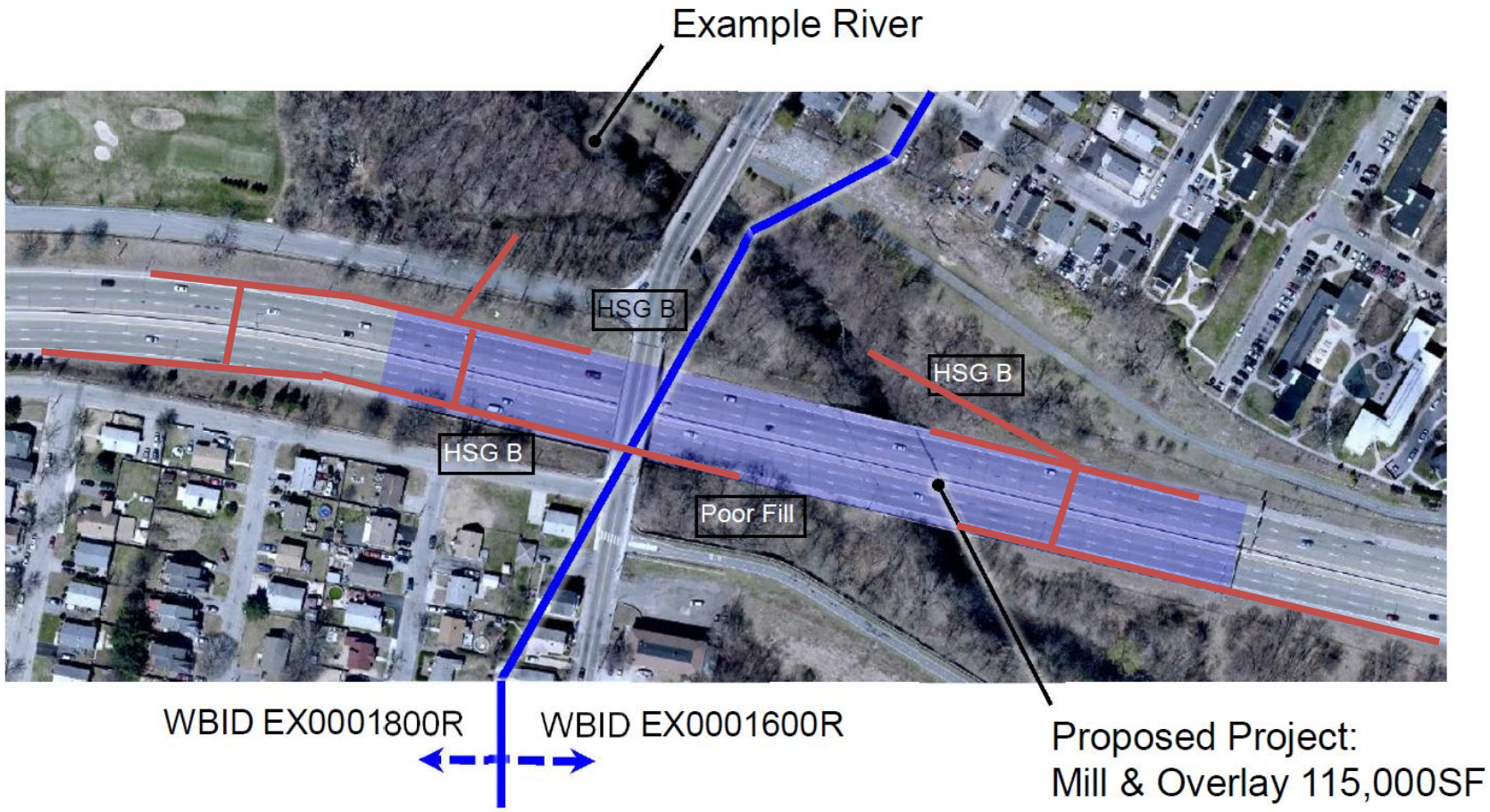
Step 2 – Assess Stormwater Infrastructure

Drainage Assessment

Drainage does not stay in the LOD…you must look outside the LOD



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Section 1.1 - Scoping

PART 1 – STUDY

Table 1.1.1 – Environmental Considerations

Environmental Considerations	Potential Impacts to Projects
Hazardous Waste Sites	The presence of contaminated soils may impact ability to infiltrate stormwater. The RIDEM Office of Waste Management (OWM) will need to be contacted.
Cold Water Fishery	Restrictions apply for stormwater management practices when working in a watershed that contributes runoff to a cold-water fishery. This information can be found following the tasks in Step 3.1 of *Section 1.1 – Scoping* (follow the same steps as you would for identifying a TMDL in Step 3.1(C)).
Wetlands	Work within or around wetland boundaries will require permitting through RIDEM Office of Water Resources Freshwater Wetlands and/or Coastal Resources Management Council (CRMC). Refer to the online RIDEM GIS Map Room Environmental Resource Map for wetlands mapping.
Wellhead Protection Area	Work within a wellhead protection area may impact ability to infiltrate stormwater. Refer to the online RIDEM GIS Map Room Environmental Resource Map for groundwater resources mapping.
Drinking Water Supply Watershed	Work within a drinking water supply watershed may impact ability to infiltrate stormwater. Refer to the online RIDEM GIS Map Room Environmental Resource Map for drinking water supply watershed mapping.
Impaired Waterbody ID (WBID)	There are greater expectations to meet the stormwater treatment goal when discharging to an impaired WBID. Refer to Step 3.1 of *Section 1.1 - Scoping* to identify if a WBID is impaired.
RIDOT Stormwater Control Plan (SCP)	An SCP may already identify Stormwater Treatment Units (STUs) within the project limits. Contact the RIDOT Office of Stormwater Management (OSM) to determine if an SCP is available for the WBID.
Flood Zone/Floodplain	Work within a floodplain is regulated by RIDEM Office of Water Resources Freshwater Wetlands and/or Coastal Resources Management Council (CRMC). Refer to the online RIDEM GIS Map Room Environmental Resource Map for floodplain mapping.

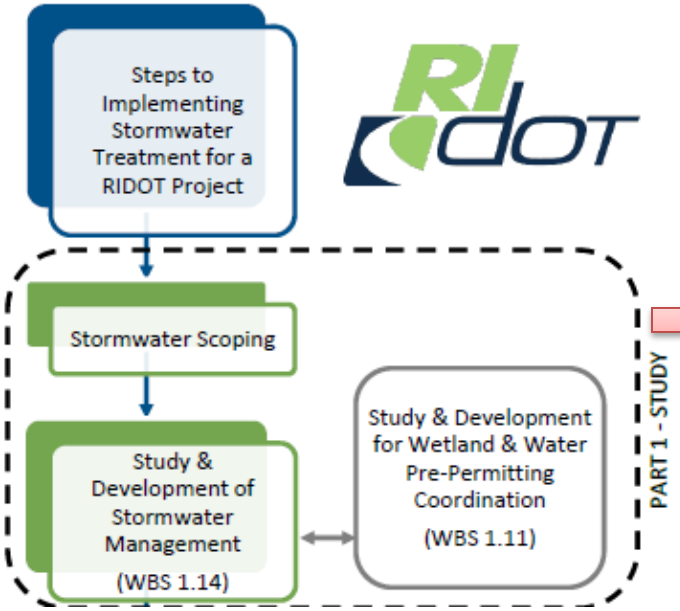
Study and Development– WBS 1.14, WBS 1.11 and Scoping

Section 1.2 – Study & Development (WBS 1.14)

1.2.1 – Introduction

1.2.2 – Steps for Stormwater Study & Development

- Step 1: Identify Pavement Reduction & Disconnection Opportunities
- Step 2: Calculate Stormwater Treatment Goals
- Step 3: Identify Site Conditions
- Step 4: Select Stormwater Treatment Units (STUs)
- Step 5: Review & Summarize Findings



DELIVERABLES WBS 1.14

- Appendix A checklist Part 1
- Worksheet A
- Worksheet B
- MEP worksheet
- Existing Drainage Mapped
- Proposed locations of STUs (proposed drainage)
- Pre-app (if recommended)
- OSM Review

30%

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Why Level of Effort (MEP)?

By the end of Study and Development you should know if your project will be simple or complex

Simple – Inexpensive

Photo by Casali Engineering

Complex – Expensive

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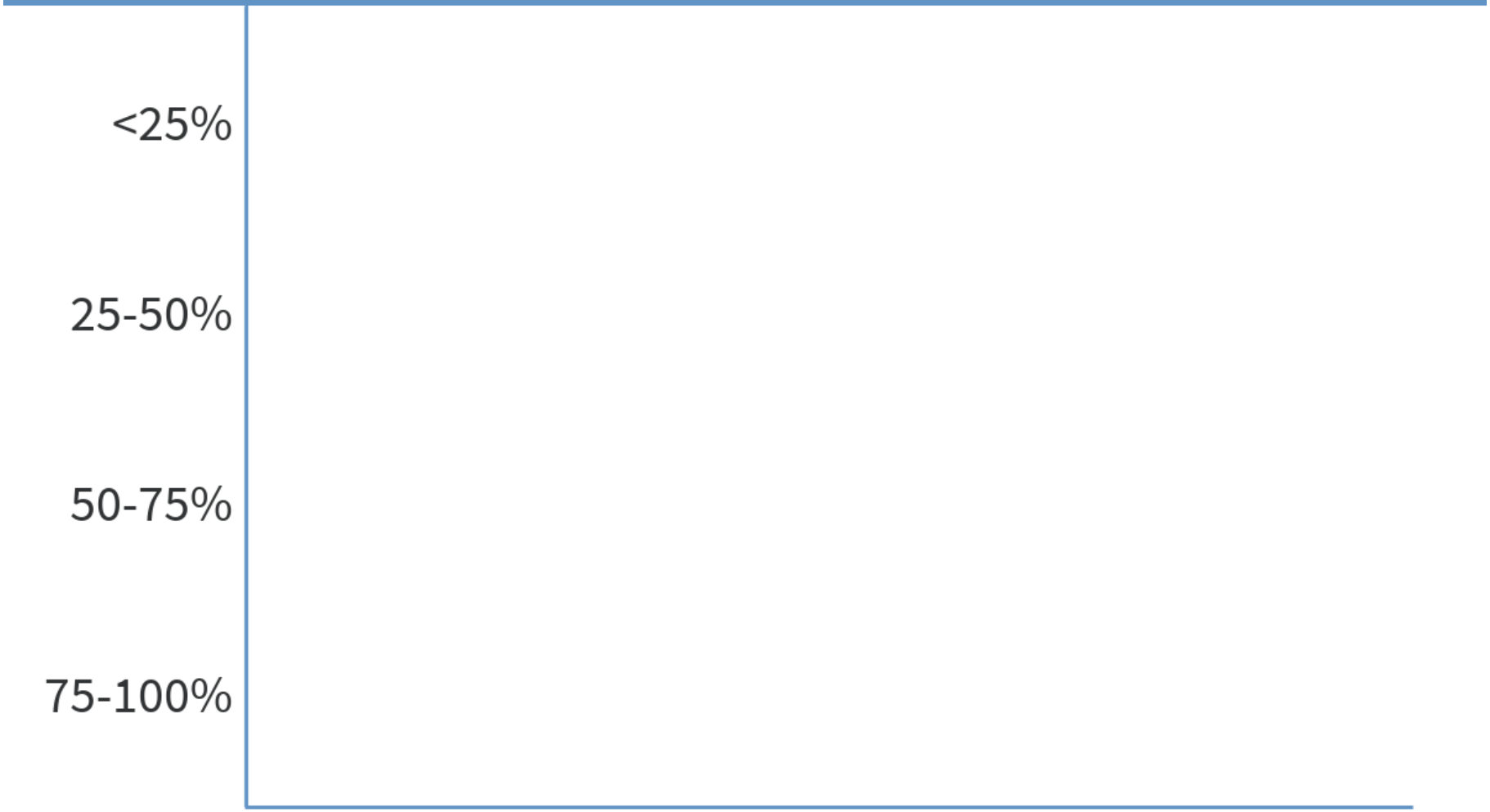
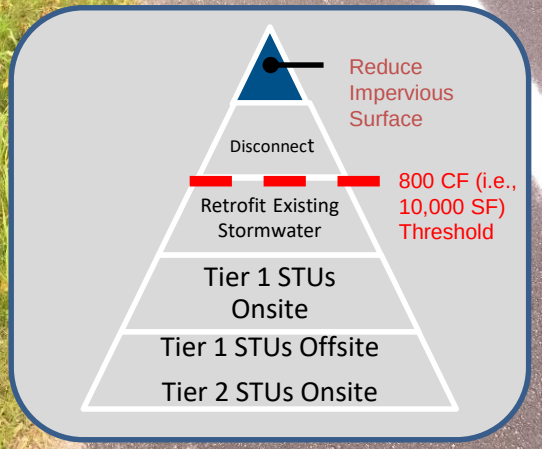
How often has stormwater implementation been significantly more challenging than you first expected?



Study and Development (WBS 1.14)

Step 1: Identify Pavement Reduction Opportunities & Disconnection

Reducing pavement is the #1 most effective stormwater practice



Stormwater Treatment Goal is by Waterbody:

+ 50% of impervious in LOD, and

+ 100% of increased impervious, or

- 100% of decreased impervious

Scenario	Project Start	Project End	Stormwater Treatment Goal
A	100,000 sqft	100,000 sqft	50,000 sqft
B	100,000 sqft	80,000 sqft	30,000 sqft
C	100,000 sqft	120,000 sqft	70,000 sqft

Also save on pavement costs

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Step 2: Calculate Stormwater Treatment Goals

Worksheet A: Stormwater Treatment Goal

Date: **Prepared By:**

Project ID: **Location:** **Municipality:**

Instructions: Enter data in unshaded boxes.

		Project Information	Stormwater Treatment Information		
Input receiving waterbody information. *1) Steps correlate to those in Section 1.1.2 of the Linear Stormwater Manual.*	A	Step 3.1(a): Enter Waterbody ID or River ID from GIS Map Server.	EX0001800R	EX0001600R	
	B	Step 3.1(a): Enter waterbody name from GIS Map Server.	Example River	Example River	
	C	Step 3.1(b): Is the WBID impaired per the RIDEM 303(d)List of Impaired Waters?	Yes	Yes	
	D	Step 3.1(c):Stormwater impairments/pollutants of concern. Enter N/A if none.			
	E	Step 3.1(d) Is there an approved SCP for the WBID? Enter N/A if no impairments.	No	No	
Input pre- & post-construction impervious areas. *Note: Correlates to Step 2.1 of Section 1.2.2 of the Linear Stormwater Manual.*	F	Total Pre-Construction[A] Impervious Area to the Waterbody (ft^2)	35,000	80,000	
	G	Total Disturbed[B] Existing Impervious Area in the Waterbody (ft^2)	35,000	80,000	
	H	Total Post-Construction[A] Impervious Area to the Waterbody (ft^2)	35,000	80,000	
Calculate treatment goal.	I	Post-Construction[A] Net Increase[C] in Pervious Surface Area (ft^2) = (F) - (H)	0	0	0
	J	Post-Construction[A] Impervious Surface Requiring Treatment (ft^2) = (G)*0.5 - (I)	17,500	40,000	0
	K	Total Stormwater Treatment Goal (ft^3) = (J)*(1/12)	1,458	3,333	0

[A] *Total area independent of phasing.*

[B] *Does not include impervious surface area disturbed during pavement marking, installing traffic induction loops, installing wheelchair ramps, crack sealing, bridge washing, and limited scale maintenance activities. Impervious surface converted to pervious surface is considered disturbed.*

[C] *Loss of pervious surface will be a negative value.*

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Step 3: ID Site Conditions and Opportunities

Step 3.1: Identify Site Conditions

Step 3.2: Identify Opportunities for Stormwater Treatment

Step 3.3: Identify Soil Conditions

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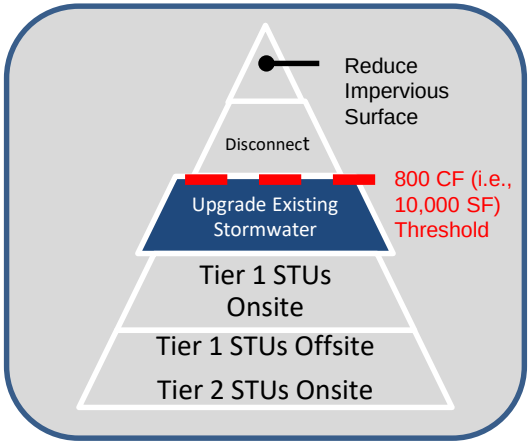
Step 4 : STU Selection (Upgrade Existing STUs)



2.1.1.2 Example Upgrade Opportunities

There are several types of existing stormwater management infrastructure that can be upgraded to improve treatment capacity. Tables 1 & 2 present some options for upgrading existing sites and existing STUs to maximize treatment capacity and storage.

Figure 2.2 – Example of a potential opportunity to use an existing depression that receives stormwater to implement a wet vegetated treatment system.

- Existing Basins to not meet DEM/CRMC/RIDOT standards, so an upgrade includes:
  - Cleaning
  - Determine if infiltration is possible
  - Pretreatment, pretreatment, pretreatment
  - Maintenance Access (if required)

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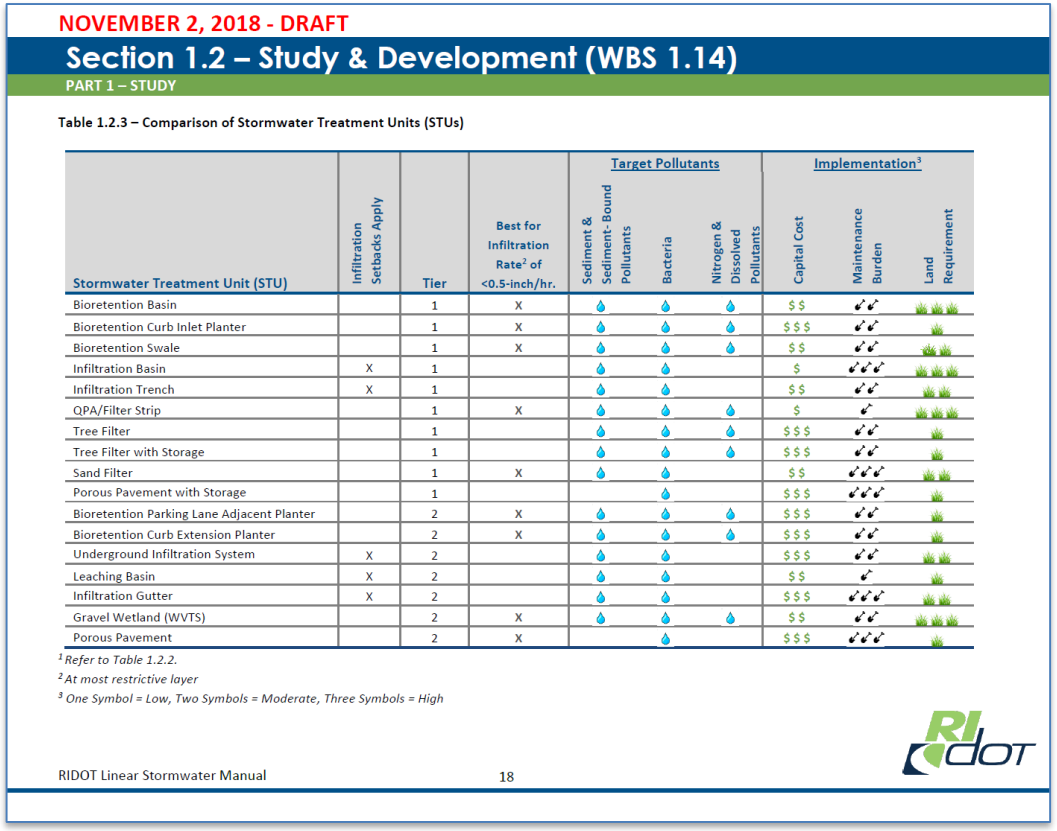
STU Selection Process

Step 4: Select Available STUs

1- Upgrade Existing STUs

2- Tier 1
- QPA/Filter Strips
- Other Tier 1 Practices

3- Tier 2 Practices



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Section 1.2 – Study & Development (WBS 1.14)

PART 1 – STUDY

Table 1.2.3 – Comparison of Stormwater Treatment Units (STUs)

Stormwater Treatment Unit (STU)	Infiltration Setbacks Apply	Tier	Best for Infiltration Rate[2] of <0.5-inch/hr.	Target Pollutants: Sediment & Sediment- Bound Pollutants	Target Pollutants: Bacteria	Target Pollutants: Nitrogen & Dissolved Pollutants	Implementation[3]: Capital Cost	Implementation[3]: Maintenance Burden	Implementation[3]: Land Requirement
Bioretention Basin		1	X	💧	💧	💧	$ $	🔧🔧	🌱🌱🌱
Bioretention Curb Inlet Planter		1	X	💧	💧	💧	$ $ $	🔧🔧	🌱
Bioretention Swale		1	X	💧	💧	💧	$ $	🔧🔧	🌱🌱
Infiltration Basin	X	1		💧	💧		$	🔧🔧🔧	🌱🌱🌱
Infiltration Trench	X	1		💧	💧		$ $	🔧🔧	🌱🌱
QPA/Filter Strip		1	X	💧	💧	💧	$	🔧	🌱🌱🌱
Tree Filter		1		💧	💧	💧	$ $ $	🔧🔧	🌱
Tree Filter with Storage		1		💧	💧	💧	$ $ $	🔧🔧	🌱
Sand Filter		1	X	💧	💧		$ $	🔧🔧🔧	🌱🌱
Porous Pavement with Storage		1			💧		$ $ $	🔧🔧🔧	🌱
Bioretention Parking Lane Adjacent Planter		2	X	💧	💧	💧	$ $ $	🔧🔧	🌱
Bioretention Curb Extension Planter		2	X	💧	💧	💧	$ $ $	🔧🔧	🌱
Underground Infiltration System	X	2		💧	💧		$ $ $	🔧🔧	🌱🌱
Leaching Basin	X	2		💧	💧		$ $	🔧	🌱
Infiltration Gutter	X	2		💧	💧		$ $ $	🔧🔧🔧	🌱🌱
Gravel Wetland (WVTS)		2	X	💧	💧	💧	$ $	🔧🔧	🌱🌱🌱
Porous Pavement		2	X		💧		$ $ $	🔧🔧🔧	🌱

[1] *Refer to Table 1.2.2.*

[2] *At most restrictive layer*

[3] *One Symbol = Low, Two Symbols = Moderate, Three Symbols = High*

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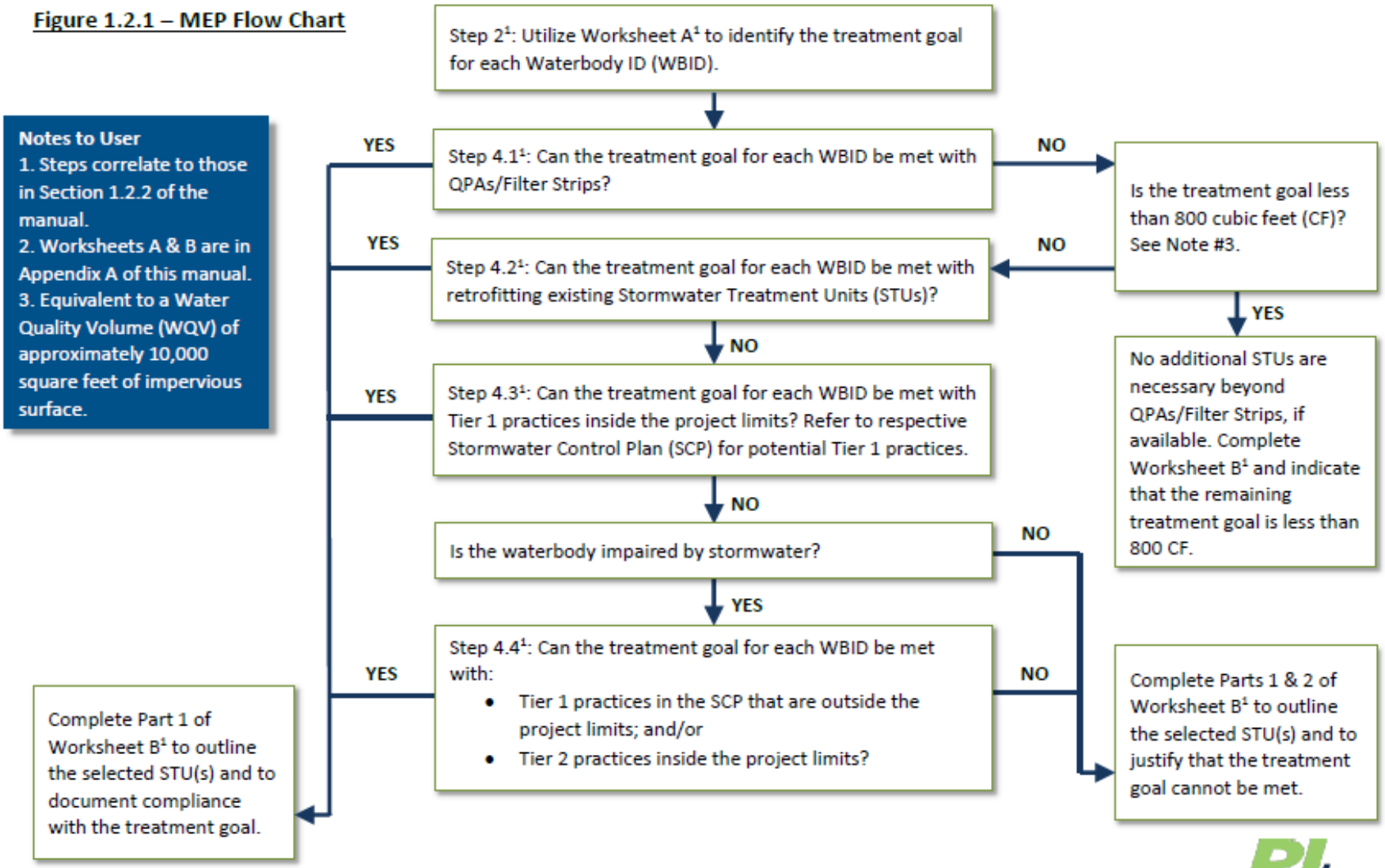
STEP 4: Select Stormwater Treatment Units (STUs)

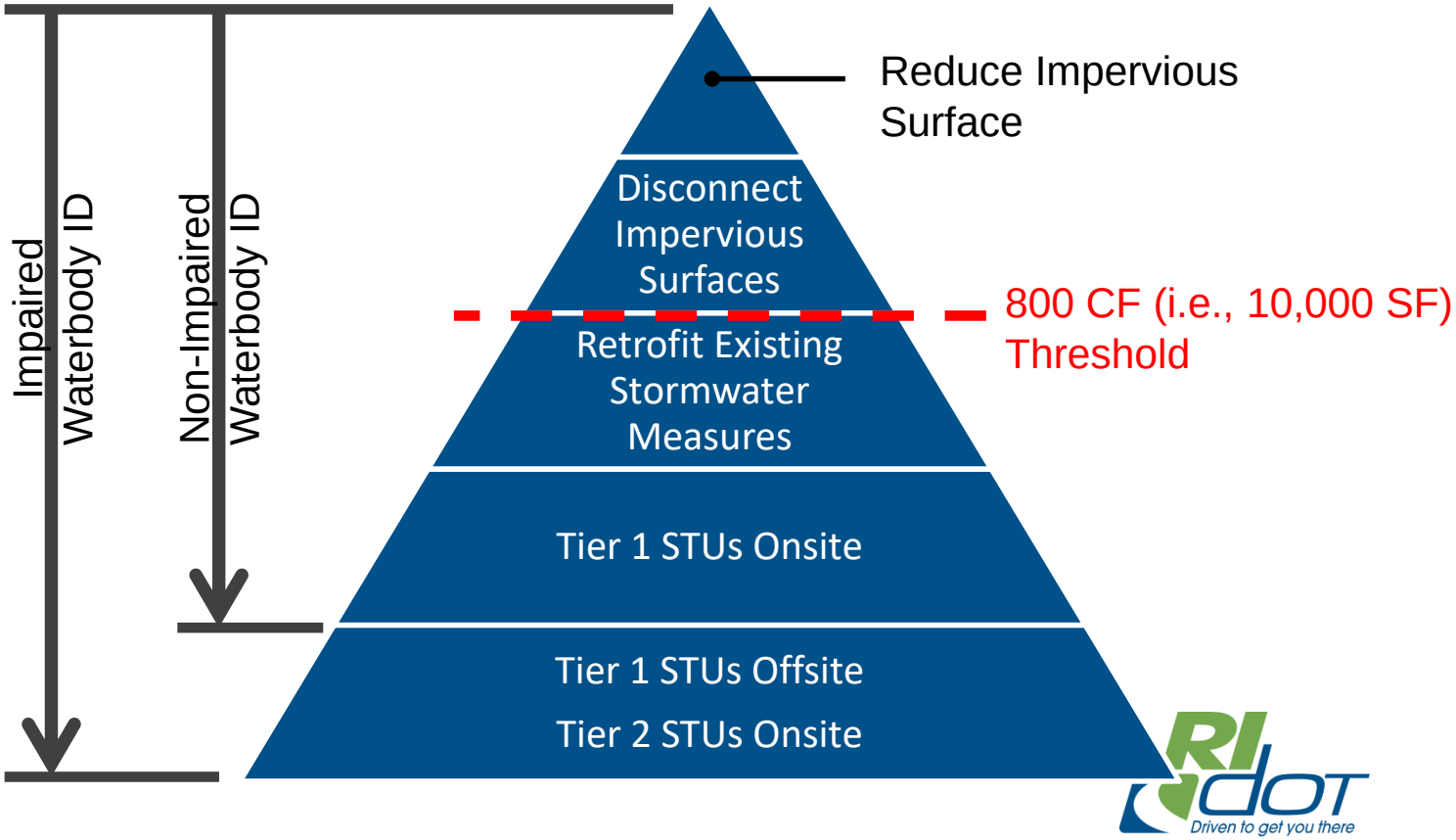
Figure 1.2.1 – MEP Flow Chart



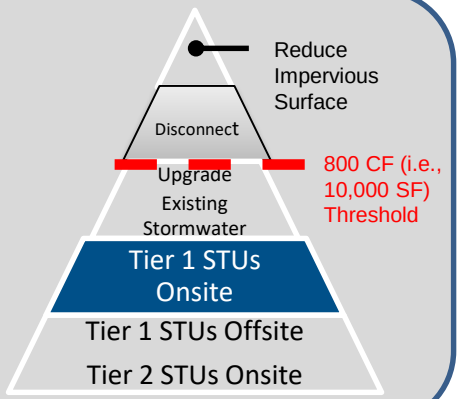
Notes to User
1. Steps correlate to those in Section 1.2.2 of the manual.
2. Worksheets A & B are in Appendix A of this manual.
3. Equivalent to a Water Quality Volume (WQV) of approximately 10,000 square feet of impervious surface.

Step 4: Select Stormwater Treatment Units (STUs)

- Upgrade existing STU
- QPA/Filter Strips
- Type 1 STUs (Infiltrating/less costly STUs per sqft)
- Type 2 STUs (More challenging – reserved for impaired waters)



Step 4 : STU Selection (QPAs or Filter Strips)



QPAs and Filter Strips are preferred RIDOT - STUs

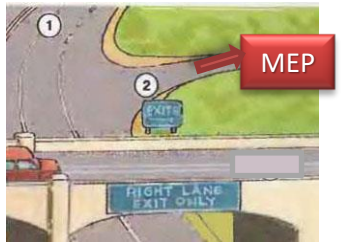
Study and Development (WBS 1.14)

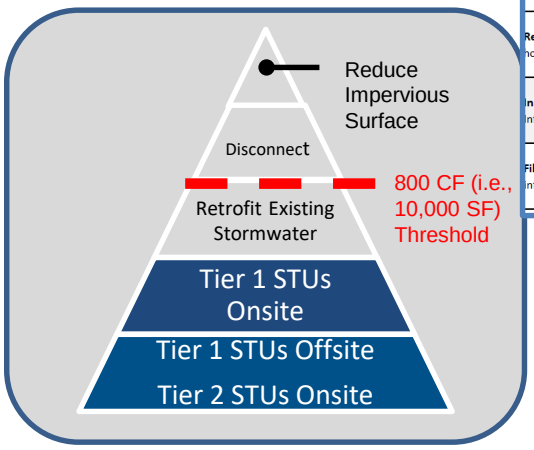
Name one or more constraints you've experienced on a stormwater project?

Evaluating Constraints

- Soils
- WaterTable
- LUHPPL
- Permitting
- Contamination
- Access
- Slopes
- ResidentialUse
- Trees
- Fill
- Other?

Step 4: Determine Availability of STUs





STU Selection & MEP Assessment

Firm Name	
Contact Name	
Phone Number	
Email Address	

Table Formatted to Print at 11 x 17 Landscape

(1) Indicates Tier 1 Practice, (2) indicates Tier 2 Practice		Infiltration Basin and Trench (1)	Bioretention Basin, Curb Inlet Planter, and Swale (1)	Tree Filter and Tree Filter with Storage (1)	QPA/Filter Strip (1)	Sand Filter (1)	Porous Pavement with Storage (1)	Underground Infiltration, Infiltration Gutter & Leaching Basin (2)
Tier 1 STUs that are Practicable for this site:		Not Practicable	Not Practicable	Not Practicable	Available	Not Practicable	Not Practicable	Not Practicable
Tier 2 STUs that are Practicable for this site:		Not Practicable	Available	Available	Available	Available	Not Practicable	Not Practicable
Practicability Constraints	**Response**	**Availablility and Conditions**						
Tight Soils - Do underlying soils have an infiltration rate < 0.5 inches/hour or are classified by the NRCS Soil Survey as Hydrologic Soil Group D?	○ Yes ◉ No	Available	Available	Available	Available	Available	Available	Available
Permitting - Does the STU location require a separate CRMC Assent or RIDEM Permit that is not already required for the project?	○ Yes ◉ No	Available	Available	Available	Available	Available	Available	Available
LUHPPL - Will runoff to the practice include discharge from a LUHPPL?	○ Yes ◉ No	Available	Available	Available	Available	Available	Available	Available
Contamination - Is the STU site regulated by RIDEM's Office of Waste Management?	○ Yes ◉ No	Available	Available	Available	Available	Available	Available	Available
Limited Access - Does the site fail to meet the maintenance access requirements specified in the Linear Manual?	○ Yes ◉ No	Available	Available	Available	Available	Available	Available	Available
Steep Slopes - Are slopes at the STU site greater than 15%?	○ Yes ◉ No	Available	Available	Available	Available	Available	Available	Available
High Water Table - Does the STU site provide the minimum vertical separation distances from the top of the filter to SHGT and bedrock?	◉ Yes ○ No	Not Practicable	Available as Tier 2 Practice with Liner and Underdrain	Available as Tier 2 Practice with Liner and Underdrain	Available with at least 18 inches of Separation	Available as Tier 2 Practice with Liner and Underdrain	Not Practicable	Not Practicable
Residential Impacts - Is the STU site within a homeowner's maintained lawn?	○ Yes ◉ No	Available	Available	Available	Available	Available	Available	Available
Inadequate Setbacks - Is the STU site within the RI Infiltration STU Setbacks (Table 1.2.2) ?	○ Yes ◉ No	Available	Available	Available	Available	Available	Available	Available
Fill - Cannot place STU in new fill, available if infiltration rate is tested or STU lined as Tier 2	◉ Yes ○ No	Not Practicable	Available as Tier 2 with Liner and Underdrain	Available as Tier 2 with Liner and Underdrain	Available	Available as Tier 2 with Liner and Underdrain	Not Practicable	Not Practicable

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Through the MEP Process – Lined Bioretention Basin was not feasible

Proposed Conditions

- Infiltration Basin (Tier 1)
- Lined Bioretention Basin (Tier 2)
- QPA/Filter Strip
- Subsurface Drainage System

Note: This example does not represent actual site conditions.

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STEP 5 : Review and Summarize Findings

- **Document results of STU Selection Process with Worksheet B**
- **Summarize Findings with Appendix A Checklist**

Worksheet B: Treatment Provided by STUs

Date: **Prepared By:**

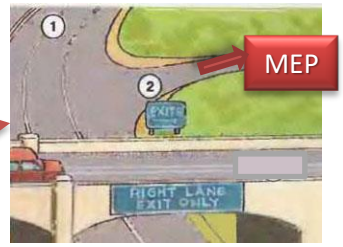
Project ID: **Location:** **Municipality:**

Instructions: Enter data in unshaded boxes.

PART 1		**Project Information**	**Stormwater Treatment Information**		
Input information from Worksheet A.	A	Enter Waterbody ID or River ID	EX0001800R	EX0001600R	
	B	Total Stormwater Treatment Goal (ft^3)	1,458	3,333	
Input STU Treatment Volumes. *Note: 1) Steps correlate to those in Section 1.2.2 of the Linear Stormwater Manual. 2) Items E & F apply only to waterbodies that are impaired by stormwater.*	C	Step 4.1: Total volume to QPAs/Filter Strips (ft^3)	1,458	200	
	D	Step 4.2: Total volume of stormwater treated by retrofitting existing STUs (ft^3)	0	0	
	E	Step 4.3: Total volume of stormwater treated by Tier 1 STUs inside the project limits (ft^3)	0	2,200	
	F	Step 4.4: Total volume of stormwater treated by Tier 2 STUs inside the project limits (ft^3)	0	800	
	G	Step 4.4: Total volume of stormwater treated by Tier 1 STUs outside the project limits (ft^3)	0	0	
Calculate Total Treatment Provided.	H	Total volume of stormwater treated (ft^3) = Sum of Items in Step 2	1,458	3,200	0
Calculate Treatment Surplus/Deficit.	I	Total volume of remaining stormwater requiring treatment (ft^3) = (G) - (A)	0	133	0

PART 2 (treatment deficit only)

Attach justification to this worksheet for treatment deficit. Utilize the STU Selection Tool in Appendix A as a basis for this justification.



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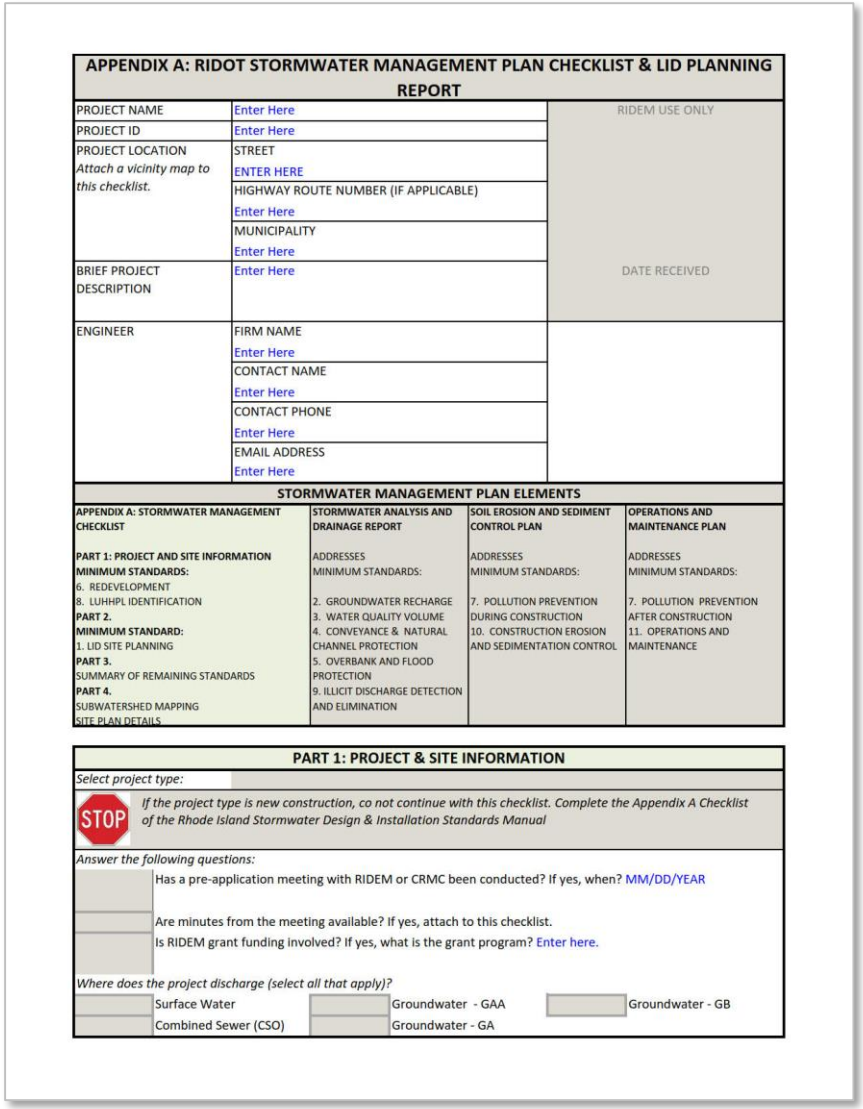
Appendix A Checklist

- Streamlined version of the RISDISM checklist for RIDOT redevelopment projects
- RIDOT new construction projects use RISDISM checklist
- Parts 1 & 2 – complete during Study & Development (WBS 1.14)
  - Submit to RIDOT OSM after completion
  - Needs to be prepared prior to pre-application meetings
- Part 3 – complete during Final Design (WBS 2.04)



APPENDIX A: RIDOT STORMWATER MANAGEMENT PLAN CHECKLIST & LID PLANNING REPORT

PROJECT NAME	Enter Here	RIDEM USE ONLY
PROJECT ID	Enter Here	
PROJECT LOCATION *Attach a vicinity map to this checklist.*	STREET ENTER HERE	
	HIGHWAY ROUTE NUMBER (IF APPLICABLE) Enter Here	
	MUNICIPALITY Enter Here	
BRIEF PROJECT DESCRIPTION	Enter Here	DATE RECEIVED
ENGINEER	FIRM NAME Enter Here	
	CONTACT NAME Enter Here	
	CONTACT PHONE Enter Here	
	EMAIL ADDRESS Enter Here	

STORMWATER MANAGEMENT PLAN ELEMENTS

APPENDIX A: STORMWATER MANAGEMENT CHECKLIST	STORMWATER ANALYSIS AND DRAINAGE REPORT	SOIL EROSION AND SEDIMENT CONTROL PLAN	OPERATIONS AND MAINTENANCE PLAN
PART 1: PROJECT AND SITE INFORMATION MINIMUM STANDARDS: 6. REDEVELOPMENT 8. LUHHPL IDENTIFICATION **PART 2. MINIMUM STANDARD:** 1. LID SITE PLANNING **PART 3.** SUMMARY OF REMAINING STANDARDS **PART 4.** SUBWATERSHED MAPPING SITE PLAN DETAILS	ADDRESSES MINIMUM STANDARDS: 2. GROUNDWATER RECHARGE 3. WATER QUALITY VOLUME 4. CONVEYANCE & NATURAL CHANNEL PROTECTION 5. OVERBANK AND FLOOD PROTECTION 9. ILLICIT DISCHARGE DETECTION AND ELIMINATION	ADDRESSES MINIMUM STANDARDS: 7. POLLUTION PREVENTION DURING CONSTRUCTION 10. CONSTRUCTION EROSION AND SEDIMENTATION CONTROL	ADDRESSES MINIMUM STANDARDS: 7. POLLUTION PREVENTION AFTER CONSTRUCTION 11. OPERATIONS AND MAINTENANCE

PART 1: PROJECT & SITE INFORMATION

Select project type:

STOP *If the project type is new construction, co not continue with this checklist. Complete the Appendix A Checklist of the Rhode Island Stormwater Design & Installation Standards Manual*

Answer the following questions:

Has a pre-application meeting with RIDEM or CRMC been conducted? If yes, when? MM/DD/YEAR

Are minutes from the meeting available? If yes, attach to this checklist.

Is RIDEM grant funding involved? If yes, what is the grant program? Enter here.

Where does the project discharge (select all that apply)?

Surface Water | Groundwater - GAA | Groundwater - GB

Combined Sewer (CSO) | Groundwater - GA

This checklist helps you cover your basis and build your permit submission…

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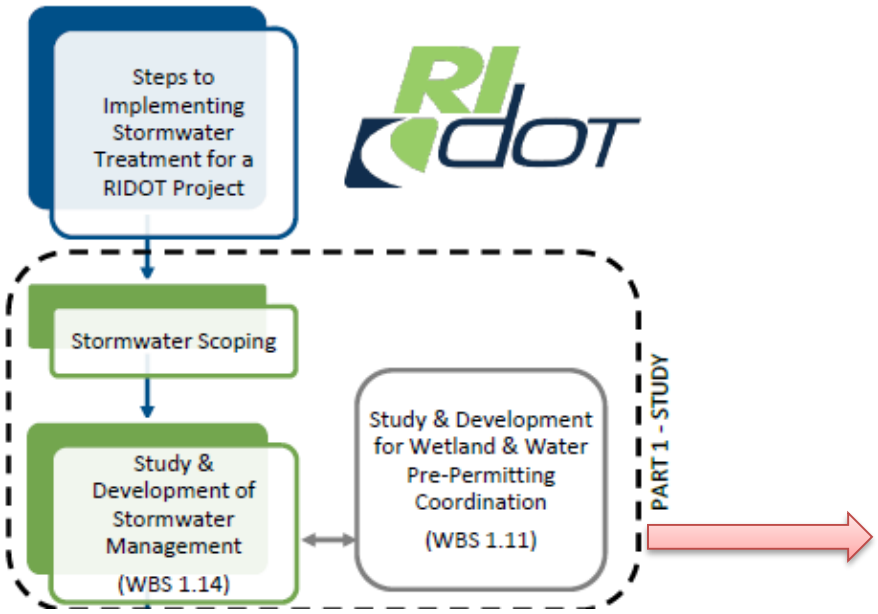
STEP 5 : Deliverables from WBS 1.14



DELIVERABLES WBS 1.14

Appendix A checklist Part 1

- Worksheet A
- Worksheet B
- MEP worksheet
- Watershed Maps

Test Pits at viable STU sites (ideally)

Existing Drainage Mapped

Proposed locations of STUs (proposed drainage)

Pre-app (if recommended)

NRU Review and knowledge of permits requred

OSM Review

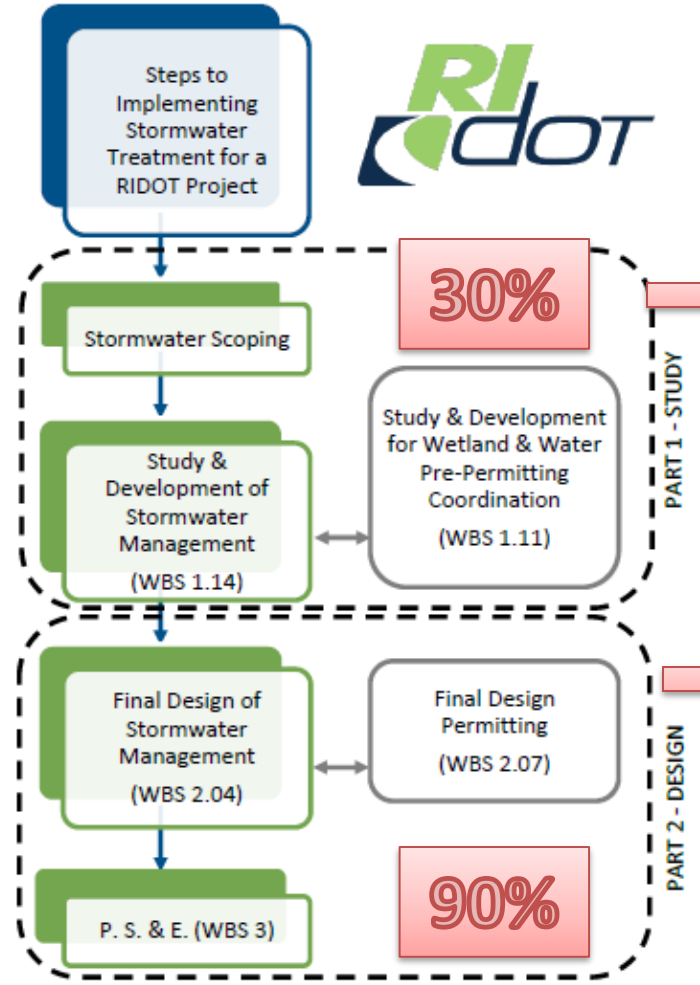


Figure P.1 – Organization of Linear Stormwater Manual

Study & Development WBS 1.14

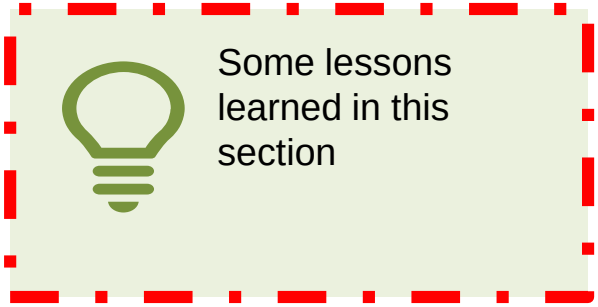
- Appendix A checklist Part 1 & 2
  - Worksheet A
- MEP worksheet
- Existing Drainage
- Pre-app (if recommended)
- OSM Review

Final Design WBS 2.04

- Appendix A checklist completed
- Hydraulic Report
- Plans/cross sections
- SESC Plan
- O&M References
- OSM Review

GENERAL INFORMATION FOR PERMITTING WBS 1.11 7 & WBS 2.07

- The Project Manager and Design Consultants are responsible to ensure proper permitting. This manual does not take the place of permitting
- When to meet with the permitting agency, if required
- Guidance and Tips linking to appropriate sections of the RIDEM Website
- Waste Management Tips
- How to handle multiple site locations



We want feedback on this…

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PART 2 – DESIGN WBS 2.04

Section 2.1 – Final Design (WBS 2.04)

- 2.1.1 – Upgrading STUs
- 2.1.2 – Inlet & Outlet Controls
- 2.1.3 – Utility Management
- 2.1.4 – Vegetation
- 2.1.**5*** – Stormwater Treatment Units
  - 2.1.5.1 QPA/Filter Strip
  - 2.1.**5.2*** Gravel Wetland (WVTS)
  - 2.1.**5.3*** Infiltration STUs
    - Infiltration Basin
    - Underground Infiltration System
    - Infiltration Trench
    - Leaching Basin
    - Infiltration Gutter
  - 2.1.**5.4*** Porous Pavement
    - Porous Pavement
    - Porous Pavement with Storage
  - 2.1.**5.5*** Filtration STUs
    - Sand Filter
    - Bioretention Basin
    - Bioretention Curb Inlet Planter
    - Bioretention Parking Lane Adjacent Planter
    - Bioretention Curb Extension Planter
    - Bioretention Swale
    - Tree Filter
    - Tree Filter with Storage
- 2.1.**6** – Pretreatment
- 2.1.7 – Maintenance Considerations

*** Bold numbers in the TOC reflect the chapter number of the RISDISM for similar stormwater treatment measures.**

General Approach

Each STU section presents design parameters that are specific to that STU. It is also recommended that the design consultant also

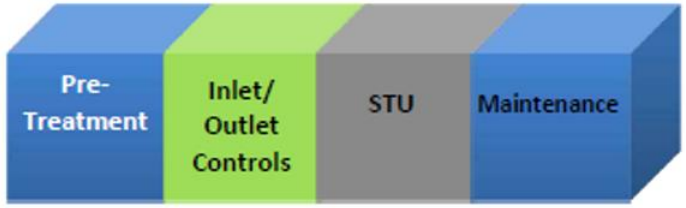

Figure 2.# - Building Blocks to a Successful STU Design

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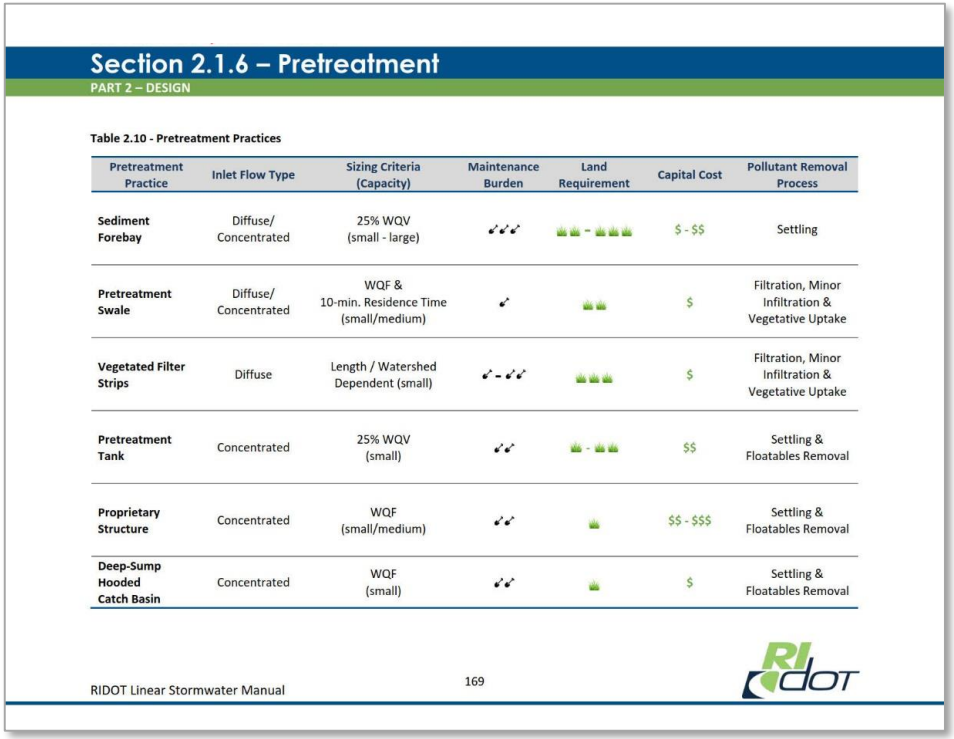
SECTION 2.1.6 - PRETREATMENT

- Captures coarse sediment & debris prior to discharging into the STU
  - Extends the service life of the STU,
  - maintains pollutant removal efficiency and
  - reduces maintenance costs
- Safe and sufficient access
- Manual provides guidance on locating, sizing & materials
- Pretreatment measures in the manual are **approved** by RIDOT maintenance



Section 2.1.6 – Pretreatment

PART 2 – DESIGN

Table 2.10 - Pretreatment Practices

Pretreatment Practice	Inlet Flow Type	Sizing Criteria (Capacity)	Maintenance Burden	Land Requirement	Capital Cost	Pollutant Removal Process
Sediment Forebay	Diffuse/ Concentrated	25% WQV (small - large)			$ - $$	Settling
Pretreatment Swale	Diffuse/ Concentrated	WQF & 10-min. Residence Time (small/medium)			$	Filtration, Minor Infiltration & Vegetative Uptake
Vegetated Filter Strips	Diffuse	Length / Watershed Dependent (small)			$	Filtration, Minor Infiltration & Vegetative Uptake
Pretreatment Tank	Concentrated	25% WQV (small)			$$	Settling & Floatables Removal
Proprietary Structure	Concentrated	WQF (small/medium)			$$ - $$$	Settling & Floatables Removal
Deep-Sump Hooded Catch Basin	Concentrated	WQF (small)			$	Settling & Floatables Removal

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SECTION 2.1.2 – Inlet and Outlet Controls

- Guidance is based on STU type and location
- Considers RIDOT operational and Maintenance requirements (e.g., snow plowing along curbs, maintaining structures, etc.)
- Inlet structures include level spreader, curb cuts and pipes
- Outlet structures include risers, weirs and culverts

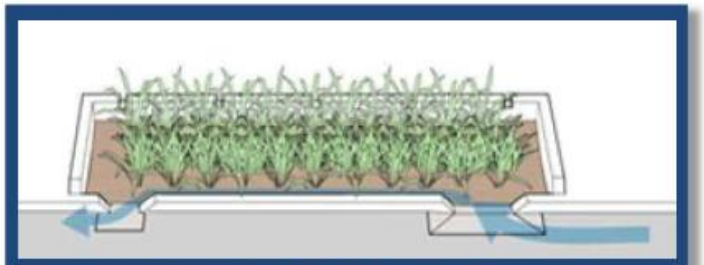

Figure 2.7 - Outlet Curb Cut Opening – Through-Flow Type (NACTO, June 2017)

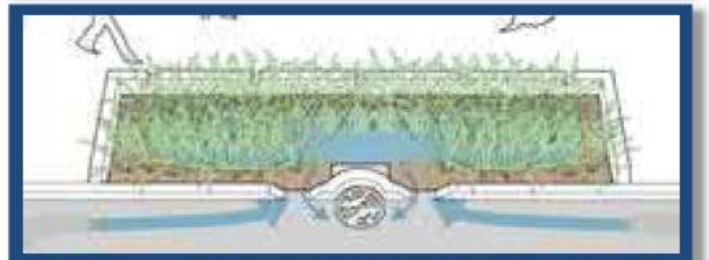

Figure 2.8 - Combined Inflow/Overflow Curb Cut Opening (Source: NACTO, June 2017)

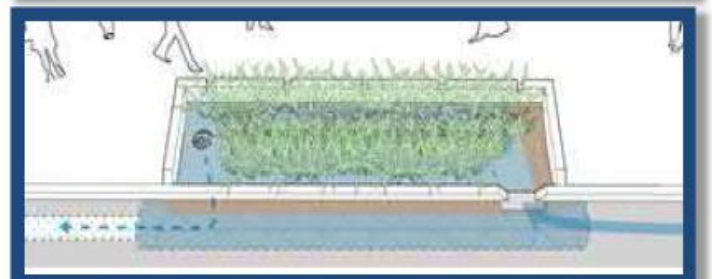

Figure 2.9 - Raised Overflow Structure (Source: NACTO, June 2017)

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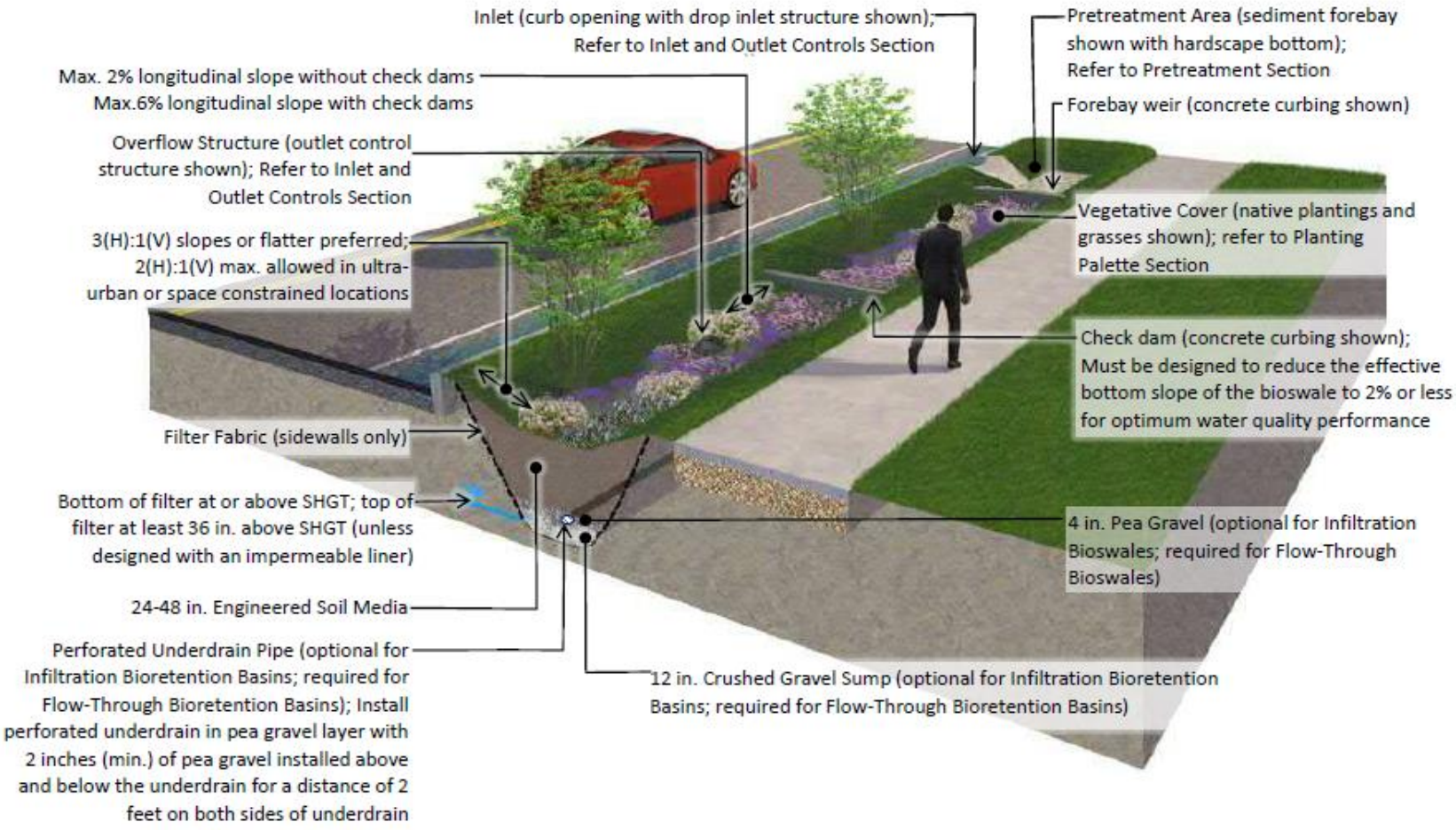
Section 2.1.5.5 – Bioretention Swale

PART 2 – DESIGN



SECTION 2.1.5 – Offers Bioretention Options

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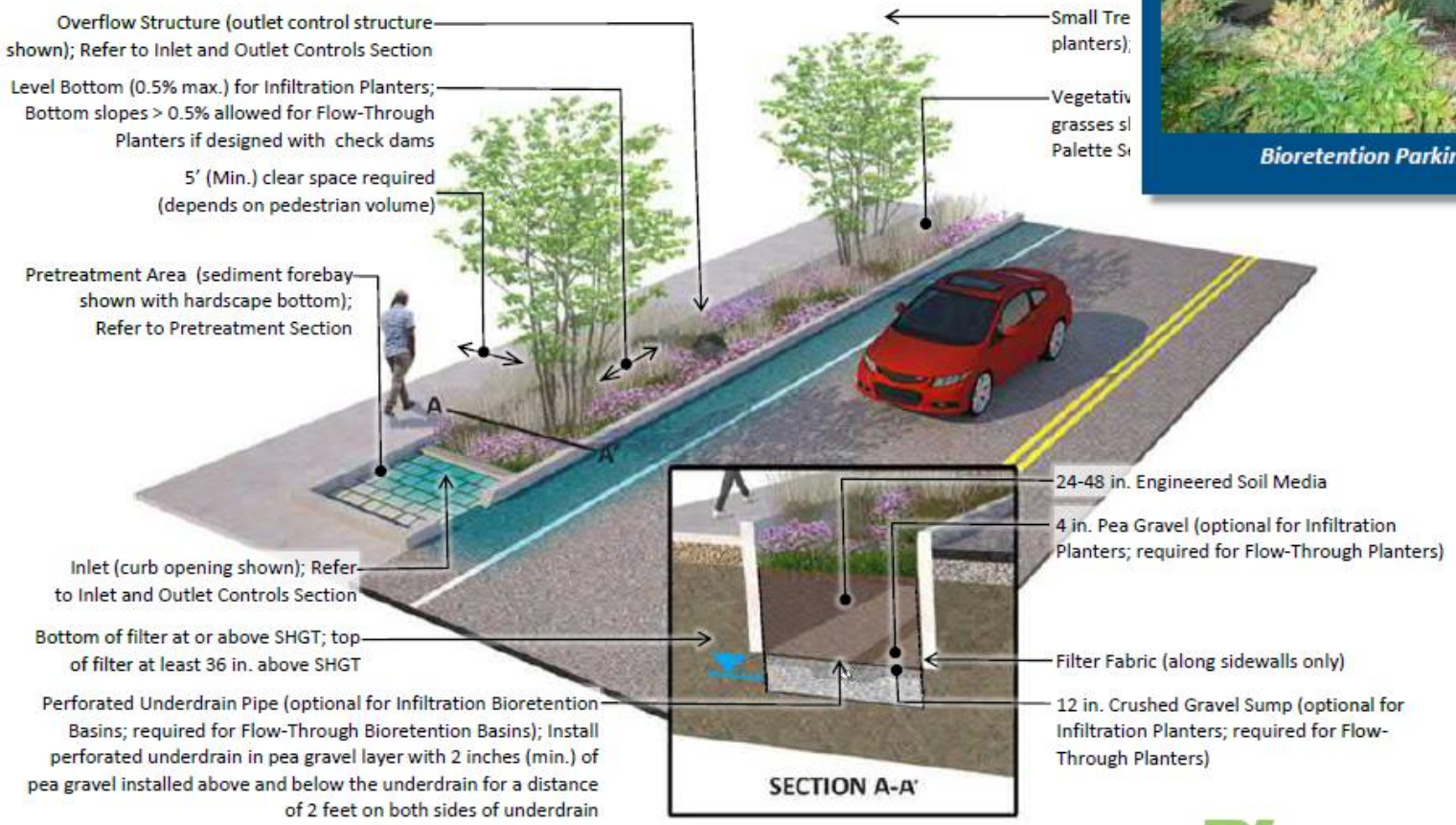
Section 2.1.5.5 – Bioretention Curb Inlet Planter

PART 2 – DESIGN

Bioretention Parking Lane Adjacent Planter



NOVEMBER 2, 2018 - DRAFT

Section 2.1.5.5 – Tree Filter

PART 2 – DESIGN

- Maximum for Overflow Events: 9 inches (preferred) to 12 inches (absolute maximum)
- Ponded water shall drain from tree filter within 48 hours or less. Underdrains can be added, as necessary, to accommodate drain time requirement.

- Bottom Width
  - Minimum: 5 feet
- Bottom Slope
  - Design bottom of tree filter to be level or have a maximum slope of 0.5% to promote infiltration and even distribution.
- Drainage Layer (Optional)
  - Install drainage layer below engineered soil media, consisting of 4" minimum pea gravel layer atop 8" minimum gravel sump.
  - Do not use filter fabric above or below drainage layer; if drainage layer extends below base of concrete tree filter vault, use filter fabric on sides of drainage layer

Materials

- Engineered Soil Media
  - Depth: Engineered soil media shall have a depth of 24 to 48 inches, as necessary to accommodate WQV, subsurface conditions and the needs of the selected tree species.
  - Do not excavate soils that comply with infiltration standards for treatment in order to install engineered soil media.
  - Mix composition: Mixture composition will vary depending on target pollutants and shall have a PH of 5.2 to 7.0. Select one of the following engineered soil media mixtures from

Engineered Soil Media Mixtures (by Volume)

For bioretention basins designed as infiltration measures with no specific targeted pollutants:

Mixture 1:

- 60 to 70 percent sand;
- 15 to 25 percent topsoil (sandy loam, loamy sand, or loam per USDA soil texture) or loam (RIDOT Standards Section M.18.01); and
- 15 to 25 percent organic matter.

Mixture 2:

- 70 to 85 percent sand; and
- 15 to 30 percent organic matter.

For bioretention basins in locations where nitrogen or phosphorous are concerns:

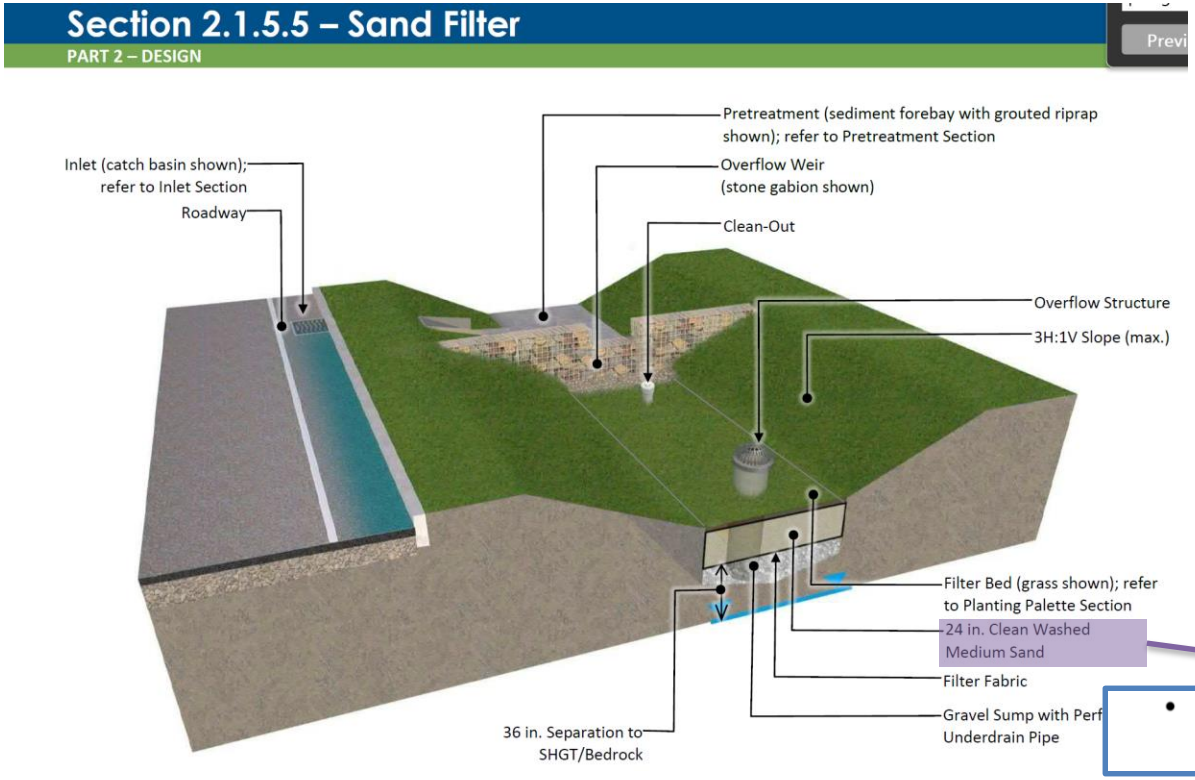
Mixture 3:

- 75 to 85 percent medium to coarse washed sand;
- 8 to 15 percent fines (silt and clay) - use a higher percentage of fines (15%) when phosphorus is a concern and use a lower percentage of fines (8%) when nitrogen is a concern; and
- 5 to 10 percent organic matter.

Mixture 4:

- 50 to 65 percent sand;
- 25 to 35 percent topsoil (sandy loam, loamy sand, or loam per USDA soil texture) or loam (RIDOT Standards Section M.18.01); and
- 10 to 15 percent organic matter.

Provides Materials Specifications



RIDOT Bluebook Specifications

- Sand
  - Shall be concrete sand conforming with Section M.02.02 of the RIDOT Standards

M.02.02 FINE AGGREGATE FOR CONCRETE. Fine aggregate for concrete shall conform to the requirements of AASHTO M6 and shall consist of natural sand, manufactured sand produced from larger aggregate, or a combination thereof. Manufactured sand shall be graded with a minimum percentage of flat elongated particles. All fine sand shall consist of hard, strong, durable particles which are free from coatings or any injurious materials and injurious amount of clay, loam, or other deleterious substances. In addition, the fine aggregate shall not contain substances which, when mixed in Portland cement concrete, produce an unacceptable level of chloride ions in the final product. Substances that produce chloride ions shall be considered deleterious material. Any fine aggregate may be rejected if it is determined by the Engineer to contain sufficient amounts of unsound or deleterious material to be harmful.

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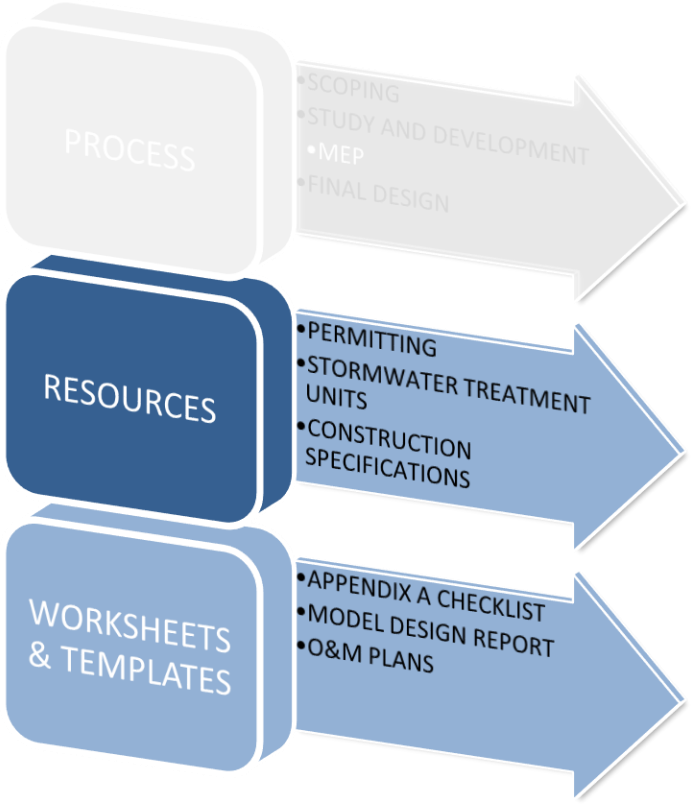
How other agencies can use this manual

- Permit Application Form
- Worksheets A & B
- STU Selection Worksheet
- SESC Template
- Drainage Report Template
- O&M Plans for each STU
- AutoCAD details
- Standard Materials
- Free to use the renderings non copywrited (i.e. presentations, grants)



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Break

- Please place questions on the respective topic boards:
  - Permitting
  - Study & Development
  - Maintenance
  - Maximum Extent Practicable
  - Design

- We will answer questions after the break.

Maintenance & Design Considerations

- Responsibility (RIDOT/non-RIDOT)
- RIDOT (Wack, Vac and Mow) otherwise need a C&M Agreement
- Delineate STUs with a Flexible Delineator Post out of mow area
- Consider Weight of Equipment
- Identify adequate space to stage maintenance activities and equipment

Figure 2.17 – Example of a Flexible Delineator Post

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Maintenance & Design Considerations

(cont.)

- Avoid the need for Specialized Equipment
- Snow Management
- Maintenance Access Paths
  - Safe entry and exit points
  - Consider Guardrail & Fence

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Q&A

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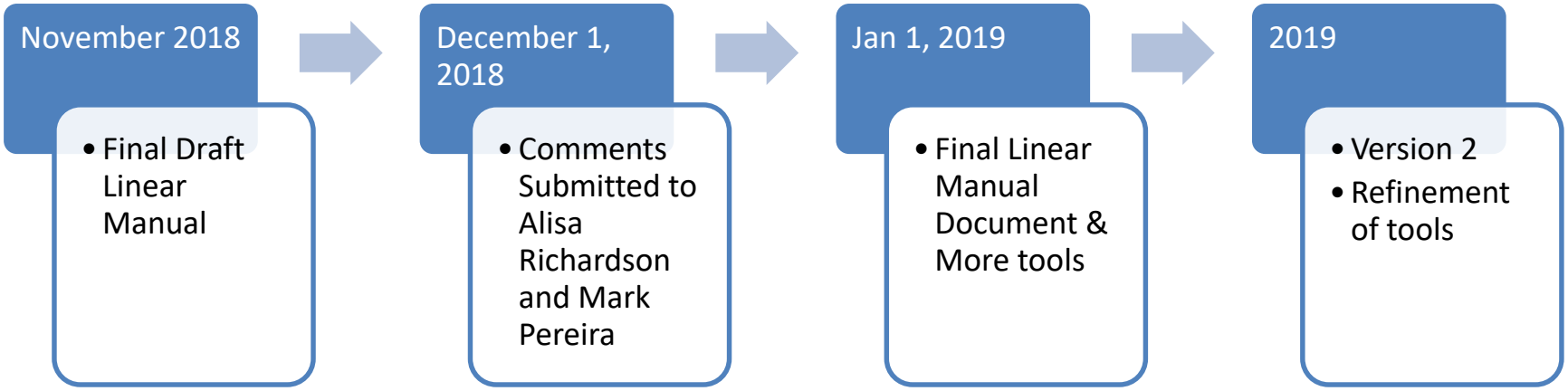
What's Next?



- To be released on the RIDOT Stormwater Website:
  - Sample Project
  - This Powerpoint Presentation
  - ACAD Files of STUs
  - MEP Worksheet
  - RIDOT Appendix A Checklist
  - Maintenance worksheets
  - Drainage Report Template

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After this workshop, I think the topic that will be the most challenging for me will be...

The Study and Development Process

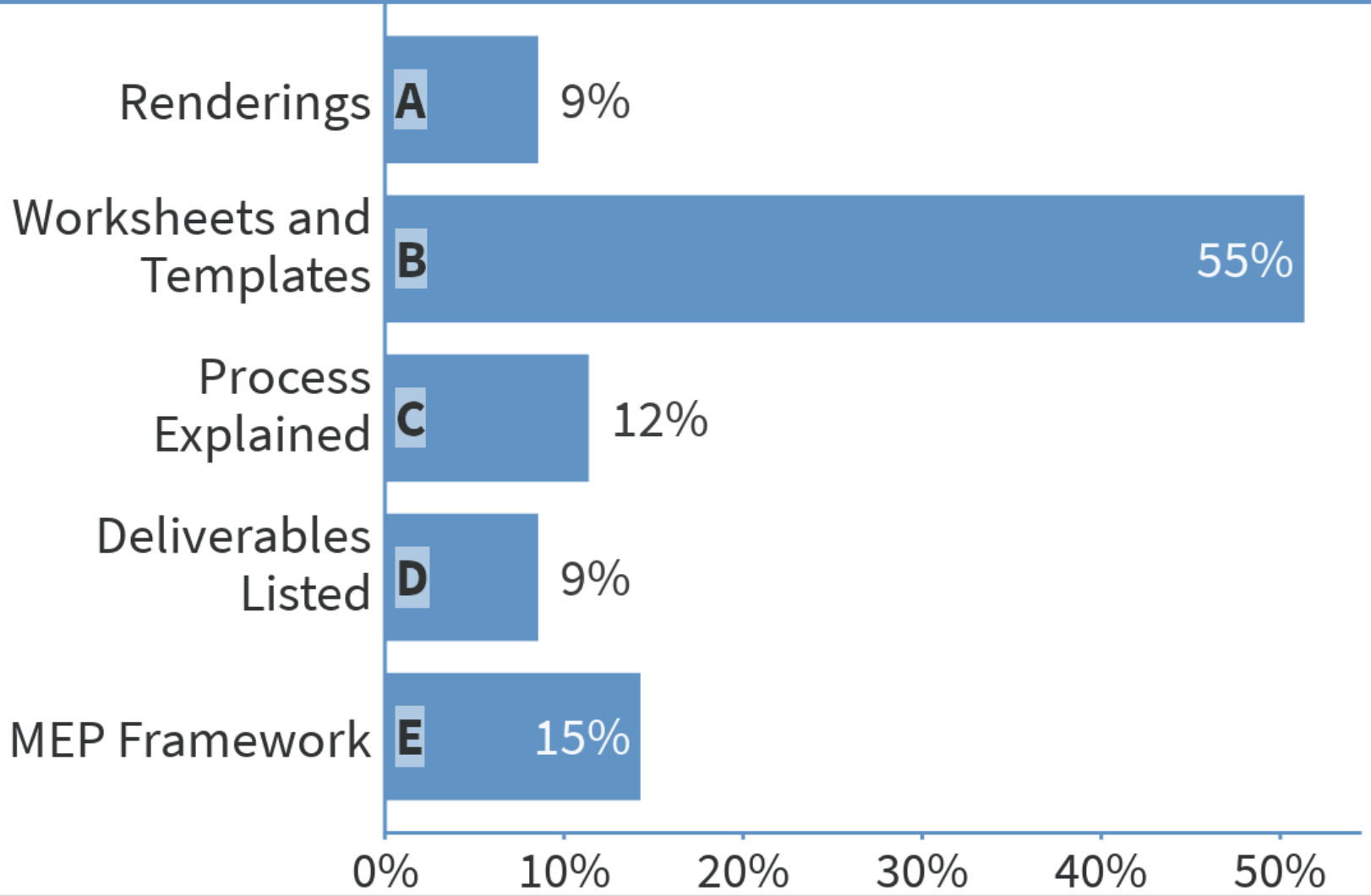
Designing STUs to RIDOT Standards

Maximum Extent Practicable

Selecting the correct STUs

Submitting the correct deliverables

After this workshop, I think the most helpful section of this manual will be...



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